

CLAIMS

1. A liquid crystal device comprising:

a substrate;

at least one photo-alignment layer applied to the substrate and which is
5 uniformly aligned with a polarised light source;

a nematic liquid crystal layer applied to the photo-alignment layer; and

a latent image formed by the photo-alignment layer and the liquid crystal
layer without the use of a mask,

wherein the latent image is viewable under cross-polarisers.

10 2. A liquid crystal device according to claim 1 wherein the at least one photo-
alignment layer is a printed layer.

3. A liquid crystal device according to claim 1 or claim 2 wherein the liquid
crystal layer is a printed layer.

4. A liquid crystal device according to any one of the preceding claims wherein
15 the latent image is formed at least partly by a pattern in the at least one photo-
alignment layer.

5. A liquid crystal device according to claim 4 wherein the photo-alignment
layer is printed on the substrate in the pattern forming the latent image.

6. A liquid crystal device according to claim 4 or claim 5 wherein the liquid
20 crystal layer covers the substrate in the entire area of the device.

7. A liquid crystal device according to any one of the preceding claims wherein
the latent image is formed at least partly by a pattern in the liquid crystal layer.

8. A liquid crystal device according to claim 7 wherein the liquid crystal layer is

printed on the photo-alignment layer in the pattern forming the latent image.

9. A liquid crystal device according to claim 8 wherein the photo-alignment layer covers the substrate in the entire area of the device.

10. A liquid crystal device according to claim 4 wherein a uniformly aligned first
5 photo-alignment layer covers the substrate in the entire area of the device, the latent image is formed by a pattern in a second photo-alignment layer applied to the first photo-alignment, and the liquid crystal layer covers at least the second photo-alignment layer.

11. A liquid crystal device according to claim 10 wherein the second photo-
10 alignment layer is printed on the first photo-alignment layer in the pattern forming the latent image.

12. A liquid crystal device according to claim 10 or claim 11 wherein the liquid crystal layer is applied to the second photo-alignment layer in the pattern representing the latent image.

13. A liquid crystal device according to claim 4 wherein the latent image is laser
15 written into the at least one photo-alignment layer.

14. A liquid crystal device according to claim 10 wherein the latent image is laser-written into the second photo-alignment layer.

15. A liquid crystal device according to claim 7 wherein the latent image is laser
20 written into the liquid crystal layer.

16. A liquid crystal device according to any one of the preceding claims wherein the liquid crystal layer is fixed by curing.

17. A liquid crystal device according to any one of the preceding claims which includes a coating over the liquid crystal layer.

25 18. A liquid crystal device according to claim 17 wherein the coating has a

refractive index which substantially matches the refractive index of the liquid crystal layer.

19. A liquid crystal device according to claim 17 or claim 18 wherein the coating covers the liquid crystal layer in such a manner to provide a device of substantially
5 uniform height.

20. A method of manufacturing a polarising liquid crystal device comprising:

applying at least one photo-alignment layer to a substrate;

uniformly aligning the photo-alignment layer with a polarised light source;

applying a liquid crystal layer to the photo-alignment layer; and

10 forming a latent image in the at least one photo-alignment layer and/or the liquid crystal layer without the use of a mask.

21. A method according to claim 20 including the step of printing the latent image in at least one of the layers.

22. A method according to claim 21 including the step of printing the liquid
15 crystal layer in a pattern representing the latent image.

23. A method according to claim 22 including the step of applying the photo-alignment layer over the substrate in the entire area of the liquid crystal device before the liquid crystal layer is applied in the pattern.

24. A method according to claim 21 including the step of printing the photo-
20 alignment layer on the substrate in a pattern representing the latent image.

25. A method according to claim 24 including the step of applying the liquid crystal area over the entire area of the liquid crystal device.

26. A method according to claim 20 including the steps of:

applying a first photo-alignment area to cover the substrate over the entire area of the device;

uniformly aligning the first photo-alignment layer with polarised light;

applying a second photo-alignment layer in a pattern representing the latent
5 image;

aligning the second photo-alignment layer with polarised light at an angle different to the alignment of the first photo-alignment layer; and

applying the nematic liquid crystal layer to the second alignment layer in the pattern representing the latent image.

10 27. A method according to claim 26 wherein the second photo-alignment layer is printed on the first photo-alignment layer.

28. A method according to claim 26 or claim 27 wherein the liquid crystal layer is printed on the second photo-alignment layer.

15 29. A method according to any one of claims 20 to 28 wherein a variable printing process is used to print the at least one photo-alignment layer and/or the liquid crystal layer.

30. A method according to claim 20 including the step of writing image areas and/or non-image areas in at least one of the layers.

20 31. A method according to claim 30 wherein a laser is used to write the image areas and/or non-image areas.

32. A method according to claim 31 wherein the uniformly aligned photo-alignment is applied over the substrate in the entire area of the device, and a UV laser is used to change the photo-alignment state of the photo-alignment layer in the image areas and/or non image areas.

33. A method according to claim 32 wherein the UV laser has a wavelength of about 280 nm or less.

34. A method according to claim 32 or claim 33 wherein the liquid crystal layer is applied to the photo-alignment layer in a pattern representing the latent image.

5 35. A method according to claim 31 wherein a laser is used to remove image areas or non-image areas of the at least one photo-alignment layer and/or the liquid crystal layer.

36. A method according to claim 35, wherein the uniformly aligned photo-alignment layer is applied over the substrate in the entire area of the device, and
10 the laser is used to ablate non-image areas of the photo-alignment layer to leave non-ablated image areas.

37. A method according to claim 36 wherein the liquid crystal layer is applied to the non-ablated image areas of the photo-alignment layer in the pattern representing the latent image.

15 38. A method according to claim 35 wherein the laser is used to ablate non-image areas of the liquid crystal layer to leave non-ablated image areas in a pattern forming the latent image.

39. A method according to any one of claims 20 to 38 further including the step of fixing the liquid crystal layer by a curing process.

20 40. A method according to claim 39 wherein UV radiation is used to cure the liquid crystal layer.

41. A method according to any one of claims 20 to 40 including the step of applying a coating over the liquid crystal layer.

25 42. A method according to claim 41 wherein the coating has a refractive index which substantially matches the refractive index of the liquid crystal layer.

43. A method according to claim 41 or claim 42 wherein the coating is applied over the liquid crystal layer so as to provide a liquid crystal device of substantially uniform height.

5 44. A polarising liquid crystal device manufactured by the method of any one of claims 20 to 43.

45. A security document or token incorporating a polarising liquid crystal device in accordance with any one of claims 1 to 19 or claim 44.

46. A security document or token according to claim 45 wherein the latent image is a portrait corresponding to the holder of the security document.

10 47. A security document or token according to claim 45 or claim 46 wherein the polarising liquid crystal device containing the latent image is provided in a window of the security document.

15 48. A security document or token according to any one of claims 45 to 47 wherein the document includes cross-polarisers in a window for verifying the latent image formed by the polarising liquid crystal device.